METHOD AND APPARATUS FOR CIRCULATING FLUIDIZED BED SCRUBBER AUTOMATED TEMPERATURE SETPOINT CONTROL

CROSS-REFERENCE TO RELATED APPLICATION(S)

The present application derives priority from U.S. provisional application Ser. No. 61/199,930, filed 21 Nov. 2008.

FIELD OF THE INVENTION

The present invention relates to a method and system for automated control of the operating temperature setpoint of a circulating fluidized bed (CFB) scrubber within a pre-determined range of approach to saturation temperatures relative to the adiabatic saturation temperature of the CFB scrubber exhaust stream.

BACKGROUND OF THE INVENTION

Power companies' efforts to reduce sulfur dioxide and other emissions have focused largely on the use of advanced emission control equipment and improving operating practices. A number of different Air Quality Control Systems (AQCS) have evolved for flue gas cleaning and desulfurization including Baghouses, Dry Scrubbers and selective catalytic reduction (SCR) devices. In most dry scrubbers, lime and water are sprayed into the gases. The lime and sulfur react to capture the sulfur, producing a waste byproduct. These scrubbers can reduce sulfur dioxide emissions by more than 95 percent. However, the incoming flue gas is very hot. It must be cooled to near its adiabatic saturation temperature wherein the gas holds as much water vapor as it can without causing adverse effects. Scrubbers control the flue gas temperature by varying their water injection rate. More water cools the flue gas more, and vice versa. The water injection rate is usually adjusted in accordance the scrubber outlet flue gas temperature, and so it is necessary to establish a scrubber exit temperature setpoint. The temperature setpoint is chosen in relationship to the gas chemistry, so that a certain margin is maintained between the scrubber outlet temperature and the water dew point (often called the adiabatic saturation temperature). This margin, often called the approach-to-saturation or ATS, is a primary control variable toward optimizing SO_2 collection efficiency. Typically this margin is maintained at 30 degrees Fahrenheit. If the temperature is too low, sulfuric acid may condense downstream resulting in corrosion of the scrubber system and also there will be problems with buildups of lime and ash on the walls and in the hoppers of the scrubber and/or downstream particulate collector (an electrostatic precipitator or fabric filter). If the temperature is too high, lime consumption is affected and the scrubber will be using more lime than required, resulting in increased operation costs.

Traditionally, no appropriate instrument has existed that was rugged enough to place into the scrubber exhaust outlet area to reliably monitor the saturation temperature. Therefore, the typical method of choosing the temperature setpoint is to manually test the saturation temperature of the flue gas by periodic hand sampling and changing the temperature setpoint accordingly. This is not ideal, as changes in several variables such as boiler load, boiler fuel or boiler operation will cause the flue gas saturation temperature to change. As a result, unless the intervals between periodic manual tests are very short, it is very difficult to maintain the ideal scrubber temperature setpoint.

It would be far more advantageous to install a more robust temperature sensor (able to withstand the harsh conditions of the CFB scrubber exhaust exit) at or near the CFB scrubber exhaust exit or at or near the outlet of the downstream particulate collector, and to monitor it to measure saturation temperature at the exit and feed periodic measurements back to a control system to directly control the water injection. With the improved control on moisture injection and the ability to monitor the flue gas dewpoint temperature in real-time, it is possible to automatically adjust the scrubber temperature setpoint within pre-determined parameters to maintain optimal scrubber conditions, thereby increasing SO_2 removal efficiency, improving scrubber system reliability and/or reducing lime consumption.

SUMMARY OF THE INVENTION

The present invention is a method and system for automated temperature setpoint control in a circulating fluidized bed scrubber. The system employs a robust temperature sensor at or near the CFB scrubber exhaust exit, or at or near the downstream particulate collector exhaust exit, in either case the temperature sensor being able to withstand the harsh conditions of the CFB scrubber/particulate collector exhaust exit. The temperature sensor output is monitored to measure saturation temperature at the exit and feed periodic measurements back to a control system to directly control the water injection and increase SO_2 removal efficiency.

Preferably, the temperature sensor is a Dewcon® Moisture Analyzer (DMA) or its functional equivalent installed at or near the CFB scrubber exhaust exit or, alternatively, at or near the downstream particulate collector exhaust exit. The DMA is in communication with the scrubber control system and measures the saturation temperature and, optionally, other variables such as relative humidity, at the exit and transmits the data to the scrubber control system using a 4-20 mA current loop. In response the measurement(s) taken by the DMA and using pre-determined temperature control settings, the scrubber control system adjusts the scrubber temperature setpoint in real time to the pre-determined optimum temperature. For example, where a 30 degree Fahrenheit margin above flue gas saturation temperature is desired and pre-programmed into the scrubber control system, if the DMA measures a saturation temperature of the flue gas at 130 degrees Fahrenheit and communicates that temperature via the current loop to the scrubber control system, the scrubber control system adjusts the outlet temperature setpoint so that a temperature of 160 degrees Fahrenheit is maintained.

BRIEF DESCRIPTION OF THE DRAWINGS

Other objects, features, and advantages of the present invention will become more apparent from the following detailed description of the preferred embodiment and certain modifications thereof when taken together with the accompanying drawings in which:

FIG. **1** is a diagram of one embodiment of the present invention incorporated in a CFB scrubber temperature measurement and adjustment feedback loop.

Corresponding reference characters indicate corresponding parts throughout the several views. Although the drawings represent embodiments of various features and components according to the present invention, the drawings are not necessarily to scale and certain features may be exaggerated in